PLATYHELMINTHES FROM SALT MARSHES OF COOMERA RIVER, SOUTHEASTERN QUEENSLAND, AUSTRALIA

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Three new species, *Childianea coomerensis* gen. et sp. nov. (Acoela), *Macrostomum greenwoodi* sp. nov. and *Macrostomum coomerensis* sp. nov. (Macrostomida) are described from the brackish water estuarine area of the Coomera river, Gold Coast, Queensland, Australia. ❐ *Taxonomy, morphology, flatworms, Acoela, Macrostomida.*

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The Australian fauna of Acoela and Macrostomida of limnetic, brackish and marine habitats is not very well known. Over a long time the only study known on Acoela was carried out by Haswell (1905) on *Heterochaerus australis*. More recently, however, more intensive studies have been started by Trench & Winsor 1987 on *Amphiscolops* sp. and *Haplodiscus* sp. (in part *Waminoa litus* Winsor, 1990), Winsor 1988 on *Wulguru cuspidata*, Winsor 1990 on *Convolutriloba hastifera*, *Waminoa litus*, *W.* sp. 1, and *W.* sp. 2.

A first census of macrostomid species of Australia by Faubel et al. (1994) listed 6 species. Of these *Macrostomum tuba* v. Graff, 1882 and *Promacrostomum palum* Sluys, 1986 are known from freshwater environments. *Dunwichia arenosa* Faubel, Blome & Cannon, 1994, *Bradburia australiensis* Faubel, Blome & Cannon, 1994, *Macrostomum australiense* Faubel, Blome & Cannon, 1994, and *Macrostomum* sp. Faubel, Blome & Cannon, 1994, however, are all known from eulittoral habitats of sandy beaches of Stradbroke Island, South Queensland.

In the present paper one acoelous species and two macrostomid species from brackish water habitats are described.

METHODS

For studies on meiobenthos, sediment was qualitatively collected from the Coomera salt-marsh pools. The freshly collected sediment was transferred into a glass tank in a constant temperature room approximating ambient conditions (Salinity ca 30 ppt, 27°C). Habitat water was added to the sediment tank, to a depth of about 15cm. A series of 60 watt light bulbs were suspended above the tank to attract organisms into the water column. Every hour, the tank was siphoned through a 63µm sieve to collect emerged fauna. The defaunated water was then returned to the tank and the extraction process repeated until the majority of the organisms had been collected. Sexually mature specimens of Turbellaria were studied alive and in squash preparation, i.e. flattened under the increasing pressure of the coverslip as the preparation dried. Measurements of living organisms (m.l.s.) were made from squashed ones. These measurements are given in parentheses in the running text. All other measurements were made from sections of the holotype. For histological observation specimens were relaxed in 7% $MgCl_2$ and fixed in Bouin's fixative. Specimens were embedded in Paraplast plus (Reichert & Junk) and cut sagittally at 3.0µm and stained with haematoxilin-eosin according to Mayer. Types are deposited in the Queensland Museum, Brisbane.

SITE DESCRIPTION

Coomera salt-marsh (27°54'S, 153°17'E) was chosen as a site for turbellarian collection. For the past 4 years this site had been excluded from the broad-scale mosquito control measures that typically occur in southeast Queensland. It was therefore considered to be a relatively pristine site.

Coomera salt-marsh is only inundated by tides of 2.4m or more above datum. Salinity ranges between 25-38 ppt. The salt-marsh pools are 2-7m^2 in area and are bordered by dense clumps of *Sporobolus virginicus* (Kunth.) the dominant marsh-grass, and *Sarcocornia quinqueflora* Bunge (ex. Ung. Stern) a sprawling herbaceous

halophyte. The sediment consists of much highly organic mud with negligable amounts of sand.

SYSTEMATICS

Order ACOELA Uljanin, 1870
Family CHILDIIDAE Dörjes, 1968

Childianea gen. nov.

DIAGNOSIS. Childiidae with frontal organ. Body wall musculature with outer circular and inner longitudinal muscle fibers. Separate genital openings. Seminal bursa with vagina and cellular bursa mouth directed anteriad. Paired ovaries and testes. Male copulatory apparatus without seminal vesicle; proximal ejaculatory duct with sclerotised layer working as penial stylet; distal ejaculatory duct with prostatic glands. False seminal vesicles present.

TYPE SPECIES. *Childianea coomerensis* sp. nov.

ETYMOLOGY. Derived from the generic name *Childia*.

KEY TO THE GENERA OF THE CHILDIIDAE

1. with single male copulatory organ 3
   with several male copulatory organs 2
2. with 2 male copulatory organs . . *Childia* v. Graff, 1910
   with 4 male copulatory organs . . . . . *Tetraposthia* An Der Lan, 1936
3(1). . . with single male copulatory organ; without seminal bursa 4
   with seminal bursa 6
4. without male atrium or very short 5
   with long male atrium . . . . . *Atriofronta* Dörjes, 1968
5. copulatory organ with sclerotised spines . . . . . *Actinoposthia* An Der Lan, 1936
   copulatory organ with rosette like muscular elements encasing the seminal vesicle . . . . . *Parapoporus* Westblad, 1945
6(3). with seminal bursa; body muscle wall with outer circular and inner longitudinal muscle fibers. 7
   body muscle wall with inverse muscle layers . . . . . *Paraphanostoma* Steinhöck, 1931
7. with bursa nozzle. 8
   without bursa nozzle . *Pseudactinoposthia* Dörjes, 1968
8. bursa nozzle directed anteriad or caudad 9
   bursa nozzle invaginated in the seminal bursa . . . . . *Pelophila* Dörjes, 1968
9. bursa nozzle cellular 10
   bursa nozzle sclerotised . . *Philactinoposthia* Dörjes, 1968
10. male complex with prostatic glands, without seminal vesicle . . . . . *Childianea* gen. nov.
    male complex with seminal vesicle, without prostatic glands. . . . . *Archactinoposthia* Dörjes, 1968

Childianea coomerensis sp.nov.
(Figs 1A-B, 2)

ETYMOLOGY. From the Coomera River estuary on the Gold Coast of Queensland.

MATERIAL. HOLOTYPE. Coomera salt-marsh (27° 4'S, 153°17'E), Gold Coast, southeast Queensland, QM G217362, 2 specimens, May 1998 leg. B. Cameron.

DESCRIPTION. Length of body of living sexually mature specimens up to 0.9mm, when extended and gliding; maximum width up to 0.18mm in second half of body, area of growing oocytes. Body spindle-shaped with rounded frontal and rear body end, dorso-ventrally flattened. Posterior body end with a small vacuole being horseshoe-like (Fig. 1A). In transmitted light, colour of body yellowish but digestive parenchyme and lumen bright yellow through ingested diatoms. Glandular ducts of frontal organ open to exterior through several pores at the frontal end, the glands of which lie posterior to the statocyst. Secretion of the glands coarsely granulated. Statocyst embedded within the medio-frontal brain, about 55µm (m.l.s.) distant from anterior body end. Epidermal cells 2.0 - 2.5µm high, with intraepithelial nuclei; rhabdoids lacking. Epidermis completely covered with cilia 3.5 - 4.0µm in length. Body wall musculature with faint outer circular and inner longitudinal fibers. Dorsal and ventral subepidermal hyaline glands open to the exterior throughout body surface, more abundant lateral. Digestive lumen bordered by nucleus-rich parenchymal tissue which starts immediately at level of frontal glands and fills the whole mid-body covering the ovaries dorsal. Gut lumen filled with diatoms and detritus. Mouth ventral behind mid-body, about 400µm (m.l.s.) distant from frontal body end.

Reproductive system (Fig. 2). Lateral testes situated about 180µm (m.l.s.) from anterior body end. Spermatids penetrate the parenchyma on both sides lateral of the ovaries. Anterior to the transverse level of the male complex the spermatids accumulate in two false seminal vesicles which enter the common proximal ejaculatory duct in common. True seminal vesicle lacking. Ejaculatory duct is closed by a sphincter at junction of the vasa deferentia. The ventral male pore (Fig. 1B,2), 32µm distant from rear body end, leads to the bulbous pyriform copulatory organ. Muscle bulb a highly muscular complex 43µm in length with central ejaculatory duct (Fig. 2). The muscle fibers run more or less

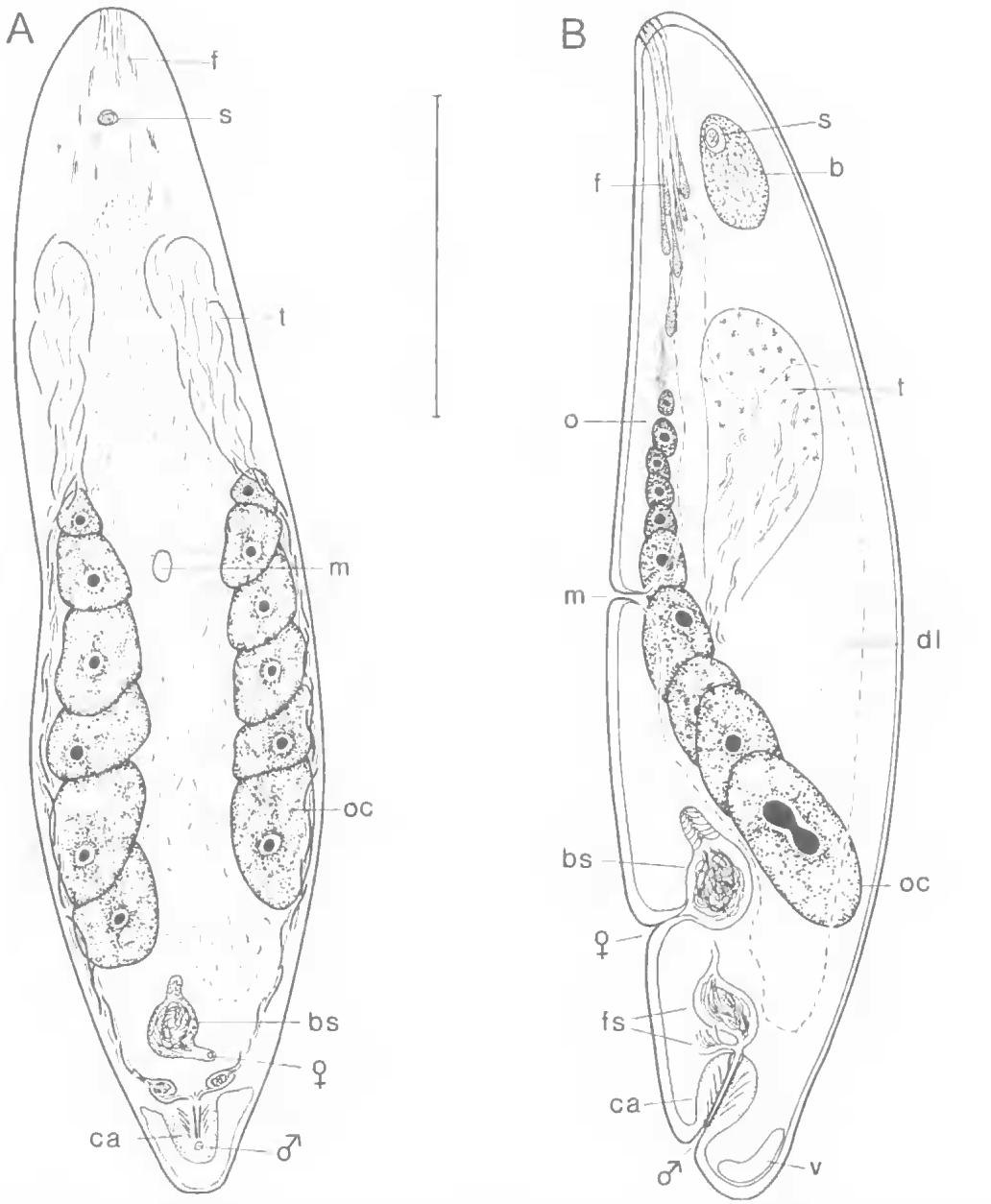

FIG. 1. *Childianea coomerensis*, gen.et sp.nov. A, dorsal view in squash preparation. B, diagrammatic sagittal reconstruction after serial sections. Scale: 200µm. (b = brain, bs = seminal bursa, bm = mouth of bursa, ca = copulatory apparatus, dl = digestive lumen, f = frontal organ, fs = false seminal vesicle, m = mouth, o = ovary, oc = oocyte, s = statocyst, t = testis, v = vacuole, ♂ = male gonopore, ♀ = female gonopore).

parallel, inclining toward the ejaculatory duct, and obviously function as retractors during copulation. Ejaculatory duct tripartite; proximal part of duct (Fig. 2) about 10µm long, highly sclerotised forming a seal controlling sperm ejaculation; central one, 31µm long, lined by a sclerotised epithelial layer looking stylet-like; distal part is 12µm long, not ciliated, and of prostatic function. Cell bodies of epithelial layer very elongated, enclose copulatory complex (Fig. 2).

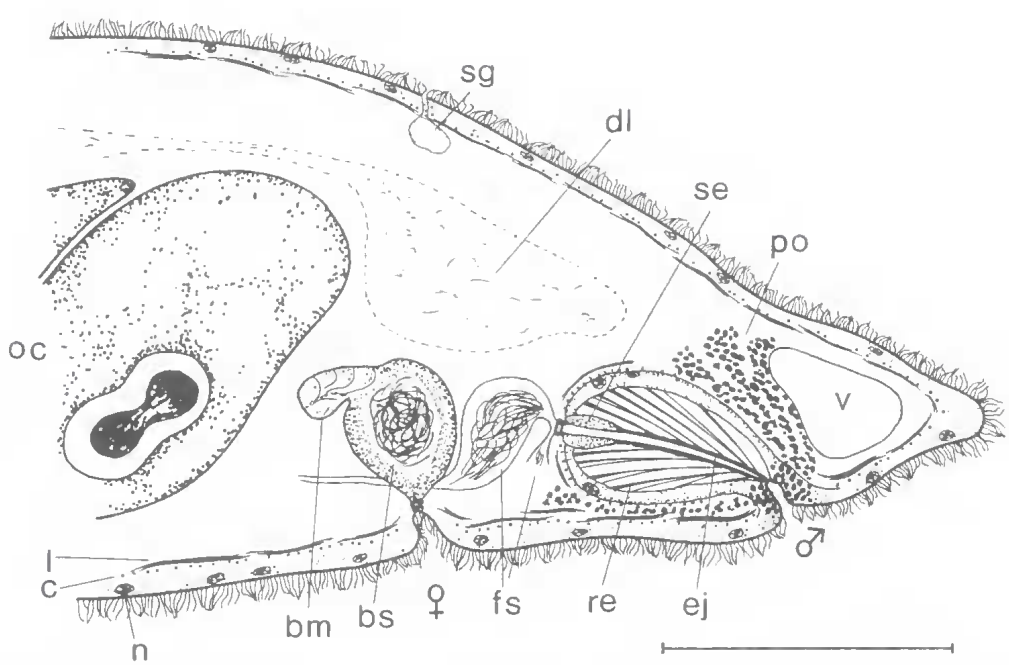

FIG. 2. *Childianea coomerensis*, gen. et sp. nov.; sagittal reconstruction of the male and female complex. Scale: 50µm. (bs = seminal bursa, bm = mouth of bursa, c = circular muscles, dl = digestive lumen, ej = ejaculatory duct, fs = false seminal vesicle, l = longitudinal muscles, n = nucleus, oc = oocyte, po = prostatoid glands, re = retractor muscles, se = seal, sg = subepidermal gland, v = vacuole, ♂ = male gonopore, ♀ = female gonopore).

Female system with paired ovaries and a seminal bursa. Oogonia of each ovary lie ventro-lateral, 190-200µm behind statocyst (Fig. 1B). A line of growing oocytes runs latero-caudad. Hindmost oocytes are about 170µm (m.l.s.) distant from posterior body end. Seminal bursa with a distal ciliated atrium (7.5µm long), a central vesicle filled with sperm (20µm in diameter), and a cellular mouth piece 13µm long. The atrium rises dorsad, 65µm anterior to male pore, widening proximad to form a vesicle filled with sperm. The cellular bursa mouth piece is directed anteriad, reaching central the hindmost part of the oocytes. Aperture between atrium and vesicle of bursa is closed by a sphincter.

DIAGNOSIS. With characters of the genus.

DISCUSSION. The family Childiidae was established and discussed in detail by Dörjes 1968. Up to now the family contains 10 genera. Dörjes included in this family all these genera of Acoela which have species with a sclerotised (cuticular according to Dörjes 1968), muscular, or cellular penis plug which is never invaginated in the seminal vesicle. The new species *Childianea coomerensis* is characterized by a sclerotised ejaculatory duct obviously working as a pointed stylet. On the basis of this character the species belongs to the Childiidae. *Coomera coomerensis*, however, differs from all species of the known genera of the family Childiidae in the presence of prostatic glands entering the distal ejaculatory duct. In combination with the characters of presence of a seminal bursa with a cellular spermiducal duct directed frontad and absence of a true seminal vesicle, establishment of monotypic *Childianea* and its species *C. coomerensis* sp. nov. is justified within the family Childiidae.

Order MACROSTOMIDA, Meixner, 1924
Family MACROSTOMIDAE Van Beneden, 1870

Macrostomum greenwoodi sp. nov.
(Fig. 3)

ETYMOLOGY. Named in honour of Prof. J. Greenwood, University of Queensland.

MATERIAL. HOLOTYPE. Coomera salt-marsh (27°54'S, 153°17'E), Gold Coast, southeast Queensland, QM G217363, 2 specimens, April 1998 leg. B. Cameron.

DESCRIPTION. Length of body of living sexually mature specimens up to 1.3mm, when

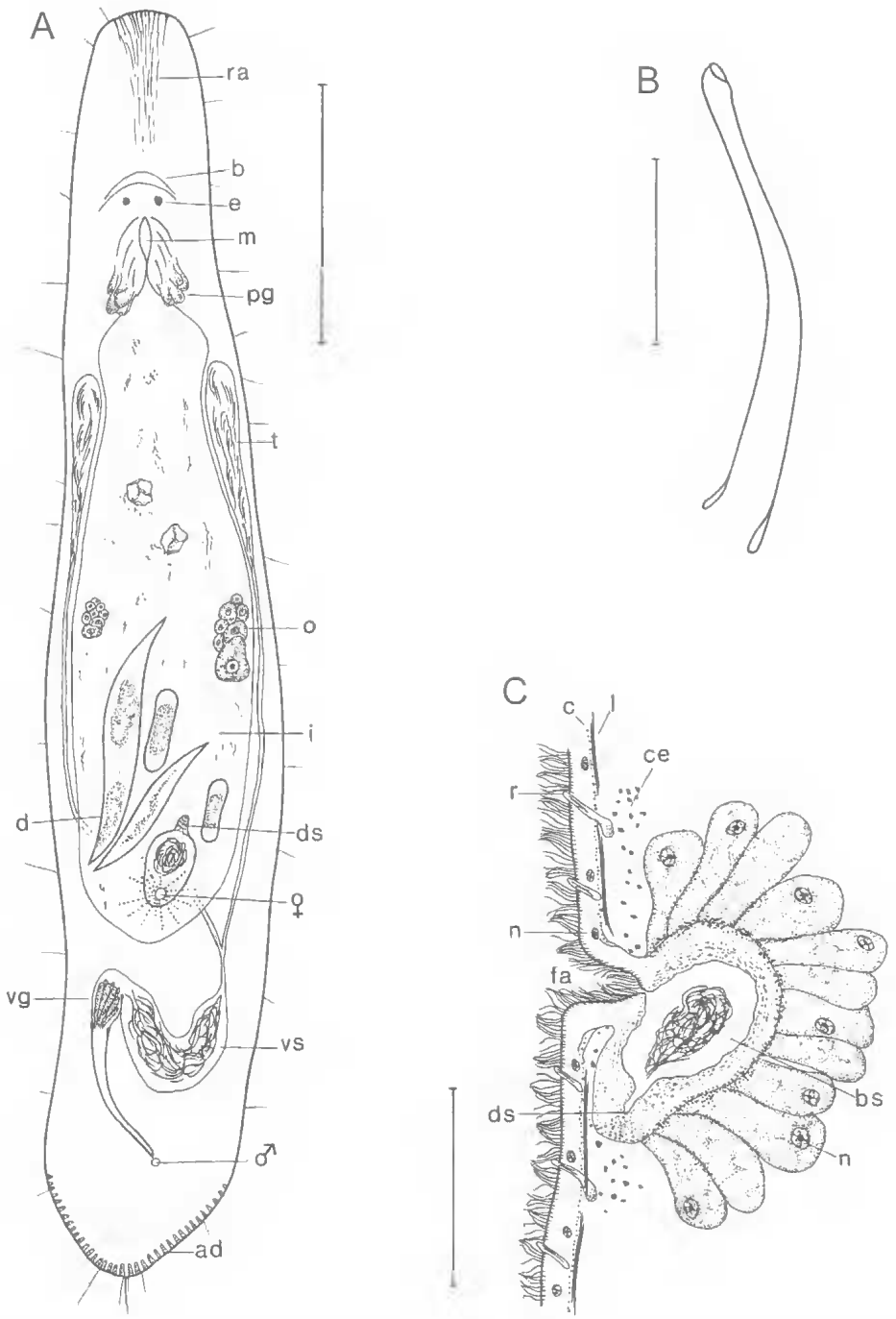

FIG. 3. *Macrostomum greenwoodi*, sp. nov. A, dorsal view in squash preparation. B, male stylet. C, sagittal reconstruction of the female organ. Scales: A, 200μm; B, 20μm; C, 50μm. (ad = adhesive glands, b = brain, bs = seminal bursa, c = circular muscles, ce = cement glands, d = diatoms, ds = spermiducal duct, e = eyes, fa = female atrium, i = intestine, l = longitudinal muscles, m = mouth, n = nucleus, o = ovary, pg = pharyngeal glands, r = rhabdite, ra = rhammites, t = testis, vg = vesicula granulorum, vs = seminal vesicle, ♂ = male gonopore, ♀ = female gonopore).

extended and gliding; maximum width up to 0.18mm in mid-body. Outline of body with characteristic macrostomid like anterior end; posterior end rounded, provided with strong adhesive glands (Fig. 3A). Around margin weak sensory hairs of varying length and stiffness present. In incident light body brownish with darker contrasting oocytes in the posterior part of body; gut intensively coloured yellow based on the uptake and consumption of bright yellow diatoms. Eyes present, 175µm (m.l.s.) far from anterior margin of the body. Crescentic brain 169µm (m.l.s.) distant from anterior end. Rhammite glands open ventro-frontal through the anterior margin of body, their cells extending posteriad up to the level of the pharynx simplex. In mid-body cells of epidermis 4.6µm high covered with 4.0 to 4.6µm (ventral) and 3.4 to 3.9µm (dorsal) long cilia. Intraepithelial nuclei present; rhabdites about 9.0µm long, the cell bodies of which subepidermal, up to 11.3µm long. Rhabdites distributed in longitudinal rows over the dorsal and ventral body surface. Body muscle wall with outer circular and inner longitudinal muscle fibers. Basal membrane not observed. Digestive system with pharynx simplex pierced by extrapharyngeal glands and large intestine but less numerous ciliated than pharynx. The intestine fills the median parts over the ovaries, oocytes, and seminal bursa and extends caudad up to the seminal vesicle. Mouth behind brain, 210µm (m.l.s.) distant from anterior end. The species feeds on diatoms and detritus particles. Ingested sand grains covered with detritus are abundant. Excretory system not observed, probably absent. Male and female gonopores separate, 185µm (m.l.s.) distant from each other.

Reproductive system (Fig. 3). The male system is typically macrostomid like. It consists of bilateral testes, vasa deferentia running caudad to either side of the intestine and ovaries, a common vas deferens, a seminal vesicle, a prostatic vesicle, and a male stylet which projects into the short male antrum. The stylet depicted in Fig. 3A, is 98.3µm long; the proximal opening is 12.0µm in diameter; the distal opening is subterminal.The male pore is 105µm (m.l.s.) distant from rear body end. The antrum rising dorsad is 10.8µm long.

The female system consists of bilateral ovaries and a seminal bursa. The ovaries forming lateral fields of oogonia, lie behind the germinative zone of the testes in mid-body (Fig. 3A), generating caudad large oocytes. The seminal bursa consists of a ciliated atrium (11.4µm long), a bursal vesicle (37.9µm long), and a spermatic duct (12.8µm long). The bursal vesicle is totally lined with elongated cells. The proper epithelium of the bursa looks syncytially in which the surrounding cells (up to 35µm) excrete obviously coarsely granulated secretion. Cement glands surrounding the female pore, discharge their secretion into the female atrium.

DIAGNOSIS. The species is diagnosed on the outline of the male stylet (Fig. 3B).

Macrostomum coomerensis sp. nov.
(Fig. 4)

ETYMOLOGY. From the Coomera river of the Gold Coast of Queensland.

MATERIAL. HOLOTYPE. Coomera salt-marsh (27°54'S, 153°17'E), Gold Coast, southeast Queensland, QM G217364, 2 PARATYPES. Same data, QM G217365-366, numerous specimens, April 1998 leg. B. Cameron.

DESCRIPTION. Length of body of living sexually mature specimens up to 1.4mm, when extended and gliding; maximum width up to 0.25mm in anterior part of second body-half, area of oocytes (Fig. 4A). Anterior and posterior body end rounded. Marginal hairs or spines absent. Frontal glands present, not reaching anterior level of brain. Eyes present immediately behind crescentic brain, 125µm (m.l.s.) distant from anterior margin of body. In incident light colour brownish yellow with contrasting darker lateral ovaries. In transmitted light body greyish translucent with yellowish digestive system. Mouth opening immediately caudal of eyes. From mouth the pharynx simplex rises dorso-caudad and receives openings of digestive glands. Intestine with less numerous cilia. The gut fills the median parts of the body extending caudad over ovaries and oocytes, ending up at the anterior level of the last oocytes. Rhabdites evenly distributed in serial lines over the body. Ventral rhabdites 7.5µm and dorsal ones 9.4µm long. Rear dorsal body end with dense aggregates of large rhabdites (10.7µm long). Ventral epidermis is 5.7µm thick and dorsal one is 2.8µm thick, entirely covered with 5.7µm long cilia; epithelial nuclei subepidermal. Basal membrane not observed. Body muscle wall with outer circular and inner longitudinal muscle fibers. Excretory system not observed, probably absent. Gonopores separate, 65µm distant from each other. Bilateral testes anterior to ovaries; last in mid-body.

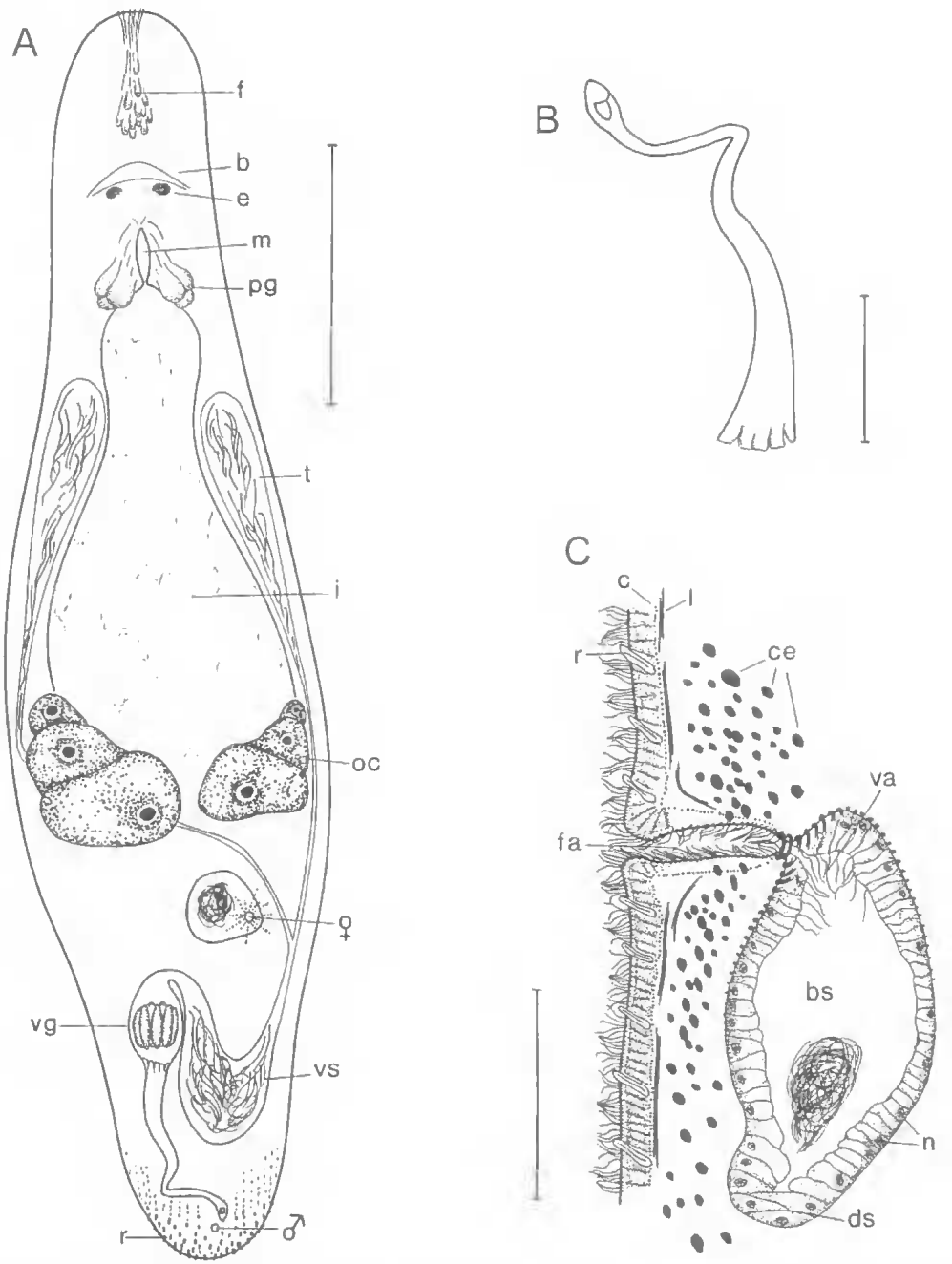

FIG. 4. *Macrostomum coomerensis*, sp. nov.; A, dorsal view in squash preparation. B, male stylet. C, sagittal reconstruction of the female organ. Scales: A, 200µm; B,C, 50µm. (b = brain, bs = seminal bursa, c = circular muscles, ce = cement glands, ds = spermiducal duct, e = eyes, f = frontal organ, fa = female atrium, i = intestine, l = longitudinal muscles, m = mouth, n = nucleus, o = ovary, pg = pharyngeal glands, r = rhabdite, t = testis, va = vagina, vg = vesicula granulorum, vs = seminal vesicle, ♂ = male gonopore, ♀ = female gonopore).

Reproductive system (Fig. 4). The male system is typically macrostomid like. It consists of bilateral testes, vasa deferentia running caudad to either side of the intestine and ovaries, a common vas

deferens, a seminal vesicle, a prostatic vesicle, and a male stylet which projects into the male antrum. The sac-like testes are located 100 to 110µm (m.l.s.) behind the pharynx. Latero-caudal of the female bursa the vasa deferentia unite to a common vas deferens on the left side before entering the seminal vesicle. The distal part of the seminal vesicle, the prostatic vesicle, and the proximal part of the penial sheath in which the stylet rests, are covered with a complicated system of strong muscle fibers. These fibers are responsible for protrusion and retraction of the stylet and ejaculation of sperm into the female system. The distal part of the prostatic vesicle is encased in the proximal portion of the stylet being slightly funnel-like extended. The stylet is 125µm (m.l.s.) long; the distal two thirds are spiralled as outlined in Fig. 4B. The distal tip of the stylet is broadend, the opening of which lies subterminally. The male pore, 42.7µm distant from the rear body end leads antero-dorsad to a rather long male antrum (15.2µm).

The female system consists of bilateral ovaries and a seminal bursa. The oogonia generate laterally immediately behind the testes and are growing up caudad forming oocytes on each side of the body. The female genital pore is 280µm (m.l.s.) distant from the caudal body end. The female atrium (43.5µm long) entered by cement glands, is outlined with cilia and rises dorsad. The transition to the vagina is closed by a sphincter. The vagina, up to 31.5µm long, ciliated, extends frontad to form a bursal vesicle filled with sperm. The cilia of the vagina up to 13.0µm long. Anteriad of the bursa a spermiducal duct (24µm long) is present. The spermiducal duct reaches up mediad to the level of the last oocytes. The epithelia of the vagina, the bursal vesicle, and the spermiducal duct are cellular with intraepithelial nuclei.

DIAGNOSIS. The species is diagnosed on the outline of the male stylet (Fig. 4).

DISCUSSION. Macrostomidae currently contains 11 genera. The dominant taxonomic characters concern the male copulatory apparatus: a distally armed ejaculatory duct (stylet), or an unarmed cirrus. Genera having a penial stylet are *Macrostomum* Schmidt, 1848, *Omalostomum* Van Beneden, 1870, *Promacrostomum* An Der Lan, 1939, *Archimacrostomum* Ferguson, 1954, *Bradynectes* Rieger, 1971, and *Bradburia* Faubel, Blome & Cannon, 1994. Of these genera, *Macrostomum* has the most species (127). Beklemishev (1951) has assigned the species of *Macrostomum* to 3 taxonomic groups as follows: *Macrostomum hystricinum* group (stylets being funnel-like proximally, with tapered hook-like shape distally), *Macrostomum orthostylum* group (stylets being straight or curved, distad evenly tapering), and *Macrostomum tuba* group (stylets having a distal characteristic *Macrostomum tuba*-like enlargement, with the opening of the ejaculatory duct in the centre of the tip, or subterminally). Although these groupings are useful in a taxonomic sense, they should not be regarded as phyletic groupings because there are different lines of the development of the female genital organs within each group. A revision of the taxon Macrostomida is in preparation by the first author. Based on the distal features of the stylet, *Macrostomum coomerensis* belongs to the *Macrostomum tuba* group and *Macrostomum greenwoodi* to the *Macrostomum orthostylum* group.

Macrostomum coomerensis is characterised by having the male stylet formed like a cork-screw with a distal enlargement, and a subterminal opening of the ejaculatory duct. On the basis of these features the species belongs to the *Macrostomum tuba* group. *Macrostomum* species with a spiral stylet are: *M. leptos* An Der Lan, 1939, *M. lewisi* Ferguson, 1939, *M. reynoldsi* Ferguson, 1939, *M. riedeli* Ferguson, 1940, *M. delphax* Marcus, 1946, *M. contortum* Beklemishev, 1951, *M. phytophilum* Beklemishev, 1951, *M. phocorum* Marcus, 1954, *M. spirale* Ax, 1956, *M. poznaniense* Kolasa, 1973, *M. bicurvistyla* Armonies & Hellwig, 1987, and *M. extraculum* Ax & Armonies, 1990. Of these species, however, only *M. leptos*, *M. reynoldsi*, and *M. extraculum* have the characteristic distal enlargement of the stylet which assigns them to the *Macrostomum tuba* group. The other species listed above belong to the *Macrostomum orthostylum* group.

Macrostomum coomerensis, *M. reynoldsi*, *M. extraculum*, and *M. leptos* are differentiated by the different length and outline of their stylets. The stylet of *M. coomerensis* (125µm in length) is essentially longer than that of both *M. reynoldsi* (72µm) and *M. extraculum* (68-72µm). For *M. leptos*, only the length of the body (0.8mm) and the outline of the stylet are known. The stylet of *M. leptos* differs greatly from that of *M. coomerensis* both in the nature of the distal swelling with subterminal pore and in having the proximal and median part of the stylet greatly

curved. Distally, the stylet is only weakly corkscrew-like.

Macrostomum greenwoodi belongs to the *Macrostomum orthostylum* group based on the curved and evenly tapered distal region of the stylet. The main distinguishing character for this species concerns the outline of the distal termination of the stylet. The distal tip in *M. greenwoodi* is obtuse, with a subterminal ejaculatory duct opening. In this respect, and in not having a cork-screw like stylet, the following 9 species resemble with *M. greenwoodi*: *M. curvituba* Luther, 1947, *M. infundibuliferum* Plotnikov, 1905, *M. johni* Young, 1972, *M. longituba* Papi, 1953, *M. lutheri* Beklemishev, 1927, *M. mediterraneum* Ax, 1956, *M. magnacurvituba* Ax, 1994, *M. mosquense* Beklemishev, 1951, and *M. tenuicauda* Luther, 1947. With the exception of *M. lutheri* and *M. greenwoodi* all other species have stylets with the ejaculatory duct opening subterminally on the concave side of the stylet. The stylets of *M. greenwoodi* and *M. lutheri* have ejaculatory openings subterminally on the convex side of the stylet. *M. lutheri* was established by Beklemishev (1927) only on the characteristic termination of the stylet. Other morphological characters are unknown. Therefore, the only main differential character resides in the complicate enlargement of the distal termination of the stylet.

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